

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 1-3, 7 and 8 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5, 648,871 to Okuyama et al. Claims 6, 11-13, and 16-18 also were rejected under 35 U.S.C. § 103 as being unpatentable over the Okuyama et al. patent. Claims 1-20 were rejected under 35 U.S.C. § 103 as being unpatentable over the published European patent application no. 0 660 169 (the “European document”) in view of U.S. Patent No. 5,490,013 to Shimizu et al. Claims 11, 12 and 16-20 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,148,036 to Matsugu et al. Applicant submits that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as previously recited in claims 1-20. Therefore, these rejections are respectfully traversed. Nevertheless, Applicant submits that claims 1-17, 19 and 20, as presented, patentably define features of the present invention.

In one aspect of the invention, independent claims 1 and 2 recite features of aberration changing optical systems for changing aberration. The optical systems include an optical element.

The optical element recited in independent claim 1 has at least one of a cylindrical surface and a toric surface. The optical element is rotatable about an optical axis of the optical system and is tiltable relative to the optical axis.

The optical element recited in independent claim 2 has different refracting powers in two orthogonal directions or has a refracting power in only one direction. The optical element is rotatable about an optical axis of the optical system and tiltable relative to the optical axis.

In other aspects of the invention, independent claims 11 and 12 recite features of a projection system for projecting a device pattern onto a wafer. The projection system includes a projection optical system and an optical element for correcting aberration produced in the projection optical system.

As recited in independent claim 11, the optical element has at least one of a cylindrical surface and a toric surface, and the optical element is inclined with respect to an optical axis.

As recited in independent claim 12, the optical element has different refracting powers in two orthogonal directions or has a refracting power only in one direction, and the optical element is inclined with respect to an optical axis.

Applicant submits that the cited art does not teach or suggest such features of the present invention, as recited in independent claims 1, 2, 11 and 12.

The Okuyama et al. patent shows an aberration correcting optical system that is rotated about an axis, which is orthogonal to an optical axis, whereby it is tilted with respect to the optical axis. Applicant submits, therefore, that in the Okuyama et al. patent, the aberration correcting optical system is not rotated about the optical axis. Further, that patent does not teach or suggest anything about rotating the aberration correcting optical system about the optical axis.

Applicant submits that the combination of the European patent document and the Shimizu et al. patent does not teach or suggest the salient features of Applicant's present invention, as recited in the independent claims.

The European patent document teaches cylindrical lenses, but does not teach a toric lens being inclined with respect to the optical axis.

Further, Applicant submits that the Shimizu et al. patent is not relevant to the present invention, since that patent merely refers to a fixed, parallel, flat plate that is inclined. This

patent, however, does not teach or suggest making a lens tiltable or, more fundamentally, tilting a lens element. Applicant submits, therefore, that even if the teachings of the European patent document and those of the Shimizu et al. patent were considered in combination, Applicant's present invention, as recited in the independent claims, would not result.

The Matsugu et al. patent shows a proximity type exposure apparatus in which there is no projection system between a mask and a wafer. Although it might be construed that the Matsugu et al. patent suggests the use of a cylindrical lens for an optical system for detecting marks of the mask and the wafer, Applicant submits that the Matsugu et al. does not specifically teach or suggest a projection system for projecting a device pattern onto a wafer.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 1, 2, 11 and 12, is patentably defined over the cited art, whether that art is taken individually or in combination.


Dependent claims 3-10, 13-17, 19 and 20 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims as requested.

Applicant submits that this Amendment After Final Rejection clearly places this application in condition for allowance. This Amendment was not earlier presented because Applicant believed that the prior Amendment placed the application in condition for allowance. Accordingly, entry of the instant Amendment, as an earnest attempt to advance prosecution and reduce the number of issues, is requested under 37 CFR 1.116.

Applicant submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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APPENDIX A

IN THE CLAIMS

1. (Amended) An aberration changing optical system for changing an aberration, said optical system comprising:

an optical element having at least one of a cylindrical surface and a toric surface, said optical element being rotatable about [and tiltable to] an optical axis of said optical system and being tiltable relative to the optical axis.

2. (Amended) An aberration changing optical system for changing an aberration, said optical system comprising:

an optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, said optical element being rotatable about [and tiltable to] an optical axis of said optical system and being tiltable relative to the optical axis.

3. (Amended) An aberration changing optical system according to Claim 1 or 2, further comprising a plurality of optical elements each being rotatable and tiltable, and wherein said optical elements are selectively used to change the aberration.

4. (Amended) An aberration changing optical system according to Claim 1 or 2, further comprising a second optical element having at least one of a cylindrical surface and a toric surface, said optical element being rotatable about [and tiltable to] the optical axis of said optical system and tiltable relative to the optical axis, integrally with the first mentioned optical element, said second optical element further being tiltable in an opposite direction to the first-mentioned optical element.

5. (Amended) An aberration changing optical system according to Claim 1 or 2, further comprising a parallel flat plate being rotatable about [and tiltable to said] the optical axis of said optical system and tiltable relative to the optical axis, integrally with the optical element, said parallel flat plate further being tiltable in an opposite direction to said optical element.

8. (Amended) A projection system, comprising:
a projection optical system; and
an aberration changing optical system as recited in any one of Claims 1 - 2, for correcting [an] aberration [to be] produced in said projection optical system.

9. (Amended) A projection exposure apparatus, comprising:
an illumination system; and
a projection system for projecting a pattern of a mask onto a substrate in cooperation with said illumination system, said projection system including a projection optical system and an aberration changing optical system, as recited in any one of Claims 1 - 2, for correcting [an] aberration [to be] produced in said projection optical system.

11. (Amended) [An optical system for a projection exposure apparatus] A projection system for projecting a device pattern onto a wafer, said [optical] projection system comprising:
a projection optical system; and
an optical element for correcting aberration produced in said projection optical system, said optical element having at least one of a cylindrical surface and a toric surface, and said optical element being inclined with respect to an optical axis.

12. (Amended) [An optical system for a projection exposure apparatus] A projection system for projecting a device pattern onto a wafer, said [optical] projection system comprising:
a projection optical system; and
an optical element for correcting aberration produced in said projection optical system, said optical element having different refracting powers in two orthogonal directions or having a refracting power only in one direction, and said optical element being inclined with respect to an optical axis.

13. (Amended) [An optical] A projection system according to Claim [11 or] 12, further comprising a plurality of said optical elements and each being rotatable and tiltable, [and] wherein said optical elements are selectively used to change the aberration.

14. (Amended) [An optical] A projection system according to Claim 11 or 12, further comprising a second optical element having at least one of a cylindrical surface and a toric surface, said second optical element being inclined with respect to the optical axis and in an opposite direction to the first-mentioned optical element.

15. (Amended) [An optical] A projection system according to Claim 11 or 12, further comprising a parallel flat plate being inclined with respect to the optical axis and in an opposite direction to said optical element.

16. (Amended) [An optical] A projection system according to any one of Claims 11 - 12, wherein said optical element is mainly composed of a transparent material of one of quartz and fluorite.

17. (Amended) [An optical] A projection system according to any one of Claims 11 - 12, wherein the or each surface of said optical element, having a refracting power, has a refractive power not greater than $3 \times 10^{-7} \text{ mm}^{-1}$.

19. (Amended) A projection exposure apparatus, comprising:
an illumination system; and
a projection system for projecting a pattern of a mask onto a substrate in cooperation with said illumination system, said projection system including a projection optical system and an optical system, as recited in any one of Claims 11 - 12, for correcting [an] aberration [to be] produced in said projection optical system.

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